DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U.S. ARMY CORPS OF ENGINEERS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-338 (SHEET 1 OF 3)

PHYSICAL SETTING

PURPOSE AND SCOPE

This hydrologic atlas is a part of a comprehensive study of the water resources of southeastern Michigan. The purpose of the atlas is to provide information on (1) the physical features of Black River and its tributaries, (2) the characteristics of streamflow, (3) the quality of ground and surface water, and (4) the ground-water aquifers of the area. This is one of a series of atlases on the several river basins in southeastern Michigan.

Physical Description

The land surface of the Black River basin, an area of 711 square miles, is principally a broad flat plain bounded on the east, north, and west by morainal hills which range from 20 to 100 feet above the general level of the plain. Morainal areas in the vicinity of Melvin and extending to the southeast also provide more hilly topography and form the boundary between Black River and one of its major tributaries, Mill Creek.

Old beach lines, representing successive stages of subsidence of former glacial lakes, are marked by local steepening of the plain. Altitudes in the basin range from 1,030 feet above mean sea level, about 4 miles southwest of Brown City, to 579 feet at the mouth of Black River.

Black River rises in the morainal hills at the northern boundary of Sanilac County and flows southward following the west edge of the belt of hills which form the eastern boundary of the basin. The river has cut several tens of feet below the adjacent plain in its upper reaches and more than 100 feet below the adjacent areas in reaches nearer its mouth. The major tributaries of Black River rise in the morainal areas at the southwest corner of the basin. Elk Creek flows northeastward to join the Black River near Sandusky, and Mill Creek flows generally eastward to join Black River nearer its mouth. Mill Creek has become deeply incised near its mouth, but Elk Creek has not cut substantially into the plain. Until about 1900, much of the central area was an uninhabitable swamp. Drainage through open ditches and drains, however, has reclaimed the land for agricultural use.

Several lakes are in the basin, but many of them may be more properly classified as ponds or borrow-pits. In the morainal and outwash areas in the southwestern part of the basin there are some fairly sizable lakes. The largest is Elk Lake, which has an area of 129 acres. Elk Creek has its source in Elk Lake.

Population and Economy

The population of the Black River basin is principally rural. The agricultural industry creates much of the wealth and is fundamental in maintaining the economy of the villages and cities. Port Huron, at the mouth of the Black River, had a population of 36,084 in 1960. The population of the other cities in the basin is generally less than 2,000.

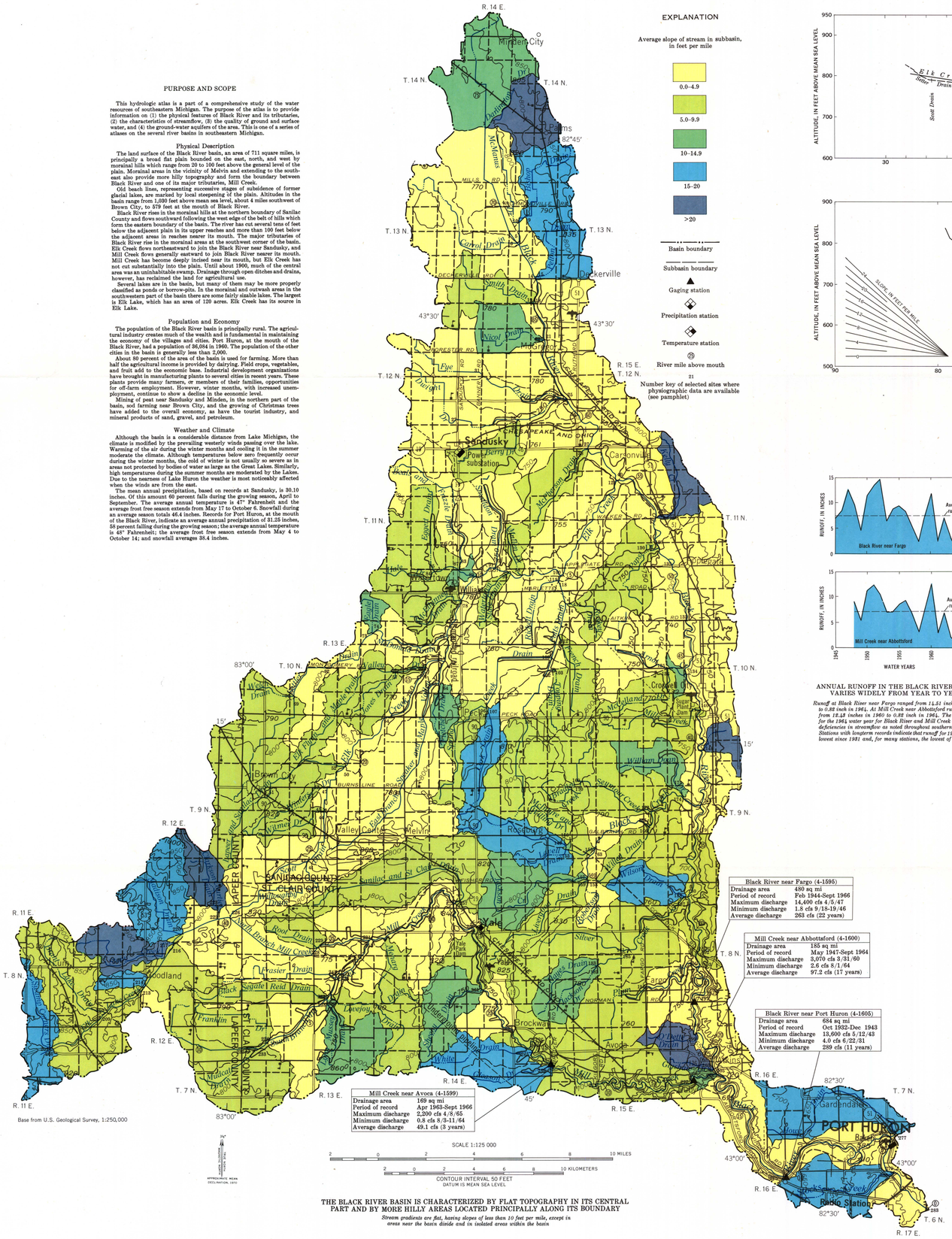
About 80 percent of the area of the basin is used for farming. More than half the agricultural income is provided by dairying. Field crops, vegetables, and fruit add to the economic base. Industrial development organizations have brought in manufacturing plants to several cities in recent years. These plants provide many farmers, or members of their families, opportunities for off-farm employment. However, winter months, with increased unemployment, continue to show a decline in the economic level.

Mining of peat near Sandusky and Minden, in the northern part of the basin, and farming near Brown City, and the growing of Christmas trees have added to the overall economy, as have the tourist industry, and mineral products of sand, gravel, and petroleum.

Weather and Climate

Although the basin is a considerable distance from Lake Michigan, the climate is modified by the prevailing westerly winds passing over the lake. Warming of the air during the winter months and cooling it in the summer moderate the climate. Although temperatures below zero frequently occur during the winter months, the cold of winter is not usually so severe as in areas not protected by bodies of water as large as the Great Lakes. Similarly, high temperatures during the summer months are moderated by the Lakes. Due to the nearness of Lake Huron the weather is most noticeably affected when the winds are from the east.

The mean annual precipitation, based on records at Sandusky, is 30.10 inches. Of this amount 60 percent falls during the growing season, April to September. The average annual temperature is 47° Fahrenheit and the average frost free season extends from May 17 to October 6. Snowfall during an average season totals 46.4 inches. Records for Port Huron, at the mouth of the Black River, indicate an average annual precipitation of 31.25 inches, 58 percent falling during the growing season; the average annual temperature is 48° Fahrenheit; the average frost free season extends from May 4 to October 14; and snowfall averages 38.4 inches.



EXPLANATION

Average slope of stream in subbasin, in feet per mile

- 0.0–4.9
- 5.0–9.9
- 10–14.9
- 15–20
- >20

Basin boundary

Subbasin boundary

Gaging station

Precipitation station

Temperature station

River mile above mouth

21 Number key of selected sites where physiographic data are available (see pamphlet)

Black River near Fargo (4-1595)	
Drainage area	480 sq mi
Period of record	Feb 1944-Sept 1966
Maximum discharge	14,400 cfs 4/5/47
Minimum discharge	1.8 cfs 9/18-19/46
Average discharge	263 cfs (22 years)

Mill Creek near Abbottsford (4-1600)	
Drainage area	185 sq mi
Period of record	May 1947-Sept 1964
Maximum discharge	3,070 cfs 3/31/60
Minimum discharge	2.6 cfs 8/1/64
Average discharge	97.2 cfs (17 years)

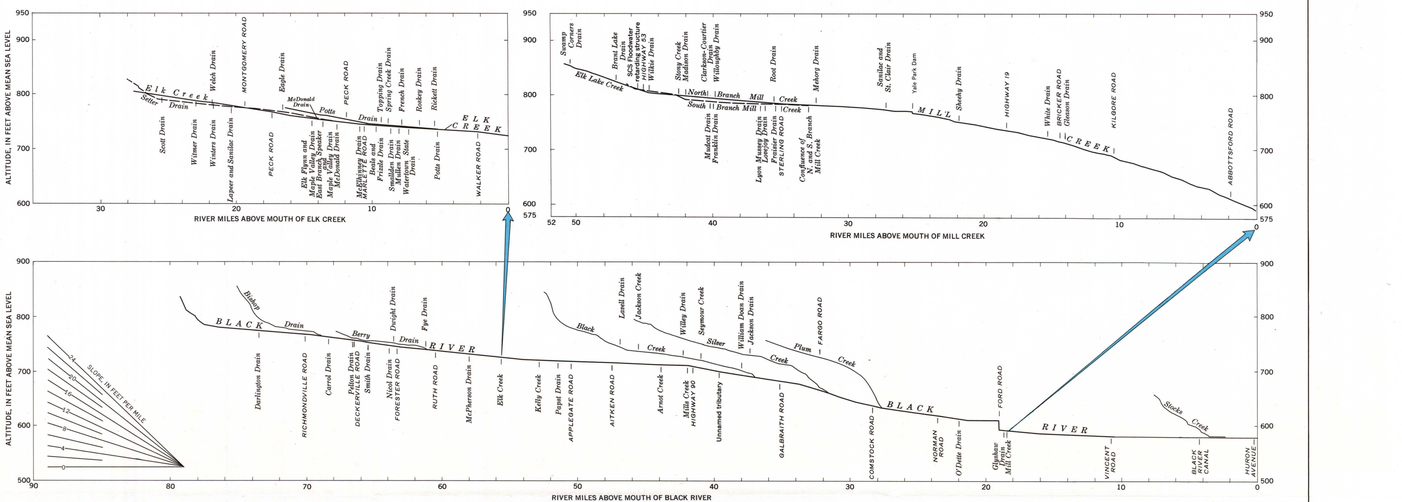
Black River near Port Huron (4-1605)	
Drainage area	684 sq mi
Period of record	Oct 1932-Dec 1943
Maximum discharge	13,600 cfs 5/12/43
Minimum discharge	4.0 cfs 6/22/31
Average discharge	289 cfs (11 years)

Mill Creek near Avoca (4-1599)	
Drainage area	169 sq mi
Period of record	Apr 1963-Sept 1966
Maximum discharge	2,200 cfs 4/8/65
Minimum discharge	0.8 cfs 8/3-11/64
Average discharge	49.1 cfs (3 years)

THE BLACK RIVER BASIN IS CHARACTERIZED BY FLAT TOPOGRAPHY IN ITS CENTRAL PART AND BY MORE HILLY AREAS LOCATED PRINCIPALLY ALONG ITS BOUNDARY

Stream gradients are flat, having slopes of less than 10 feet per mile, except in areas near the basin divide and in isolated areas within the basin

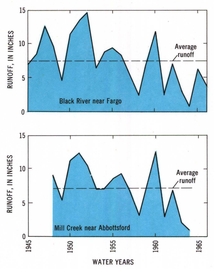
SURFACE WATER



STREAM GRADIENTS FOR THE BLACK RIVER AND ITS TRIBUTARIES ARE GENERALLY FLAT

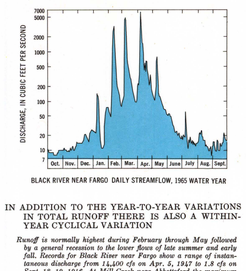
The average slope for Black River is 2.2 feet per mile; however, in many reaches the slope is less than 1 feet per mile. Elk Creek, a major tributary to Black River, has an average slope of only 2.0 feet per mile. Small gradients also characterize the upper reaches of Mill Creek; however, its slope gradually steepens in its lower reaches and it has an average slope of 5.2 feet per mile. Tributaries in the lower reaches of Black River have relatively steep gradients. In the lower reaches of these tributaries the streams fall to the level of Black River, which has cut deeply into its supporting plain, resulting in increasingly steeper slopes. Similar conditions exist on the tributaries in the lower reaches of Mill Creek.

Approximate values of slope for any reach may be determined by comparison of the profile slope with the lines for various slopes shown to the left of the Black River profile. More accurate values may be computed from the mileage and altitude values shown in the table of physiographic data (see pamphlet).



ANNUAL RUNOFF IN THE BLACK RIVER BASIN VARIES WIDELY FROM YEAR TO YEAR

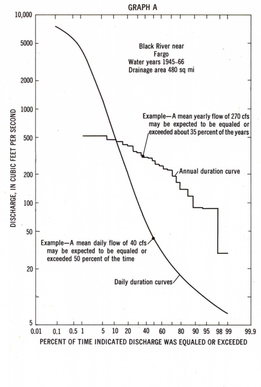
Runoff at Black River near Fargo ranged from 11.51 inches in 1952 to 0.88 inch in 1961. At Mill Creek near Abbottsford runoff ranged from 12.13 inches in 1960 to 0.82 inch in 1964. The low runoff for the 1964 water year for Black River and Mill Creek parallel the deficiencies in streamflow as noted throughout southern Michigan. Stations with longterm records indicate that runoff for 1964 was the lowest since 1931 and, for many stations, the lowest of record

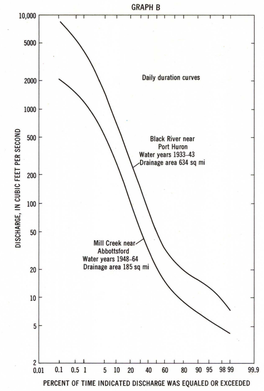


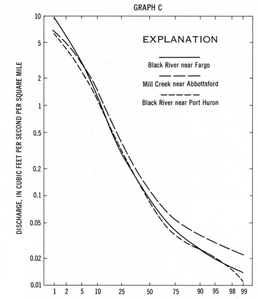
BLACK RIVER NEAR FARGO DAILY STREAMFLOW, 1965 WATER YEAR

IN ADDITION TO THE YEAR-TO-YEAR VARIATIONS IN TOTAL RUNOFF THERE IS ALSO A WITHIN-YEAR CYCLICAL VARIATION

Runoff is normally highest during February through May followed by a general recession to the lower flows of late summer and early fall. Records for Black River near Fargo show a range of instantaneous discharge from 14,400 cfs on Apr. 5, 1947 to 1.8 cfs on Sept. 18, 19, 1946. At Mill Creek near Abbottsford the maximum discharge recorded is 3,070 cfs on Mar. 31, 1960; the minimum recorded discharge is 2.6 cfs on Aug. 1, 1964







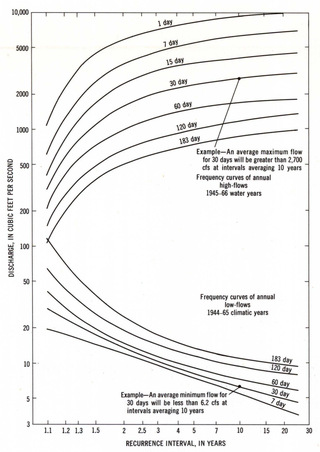
SIMILAR SHAPES IN THE FLOW DURATION CURVES INDICATE SIMILARITY OF STREAMFLOW AND BASIN CHARACTERISTICS

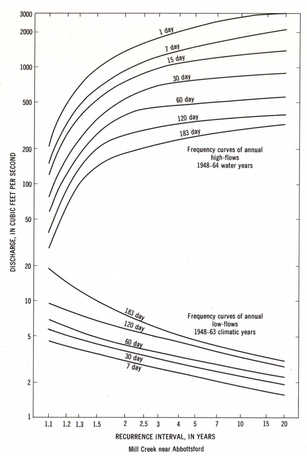
Although the curves are not for concurrent periods of record the similarity in the pattern of runoff can be recognized. Rapid runoff, characteristic of streams draining the relatively impermeable soils which predominate in the basin, is indicated by the relatively steep slope throughout the curves (graphs A and B). In graph C the effect of basin size has been eliminated from the duration curves. Here the similarity in runoff is more apparent. It will be noted, however, that Mill Creek exhibits slightly higher runoff through medium and low ranges of flow. These higher flows can be attributed to the larger proportion of more permeable surficial deposits in the Mill Creek basin. These more permeable soils permit greater infiltration of water during wet periods. The subsequent release of this ground-water storage serves to sustain streamflow, maintaining the higher discharges during dry periods

SUMMARY OF LAKES

Lake name	Surface area (acres)	Location		
		Section	Township (north)	Range (east)
Elk	120.0	10	7	11
Grass	20.0	15	7	11
No name	18.0	6	7	12
No name	7.0	5	7	13
No name	60.0	4, 5, 8	7	16
Port Huron No. 3	4.0	4	7	16
Port Huron No. 2	3.5		7	16
Port Huron No. 1	1.5	22	7	16
Rose	14.0	14	8	11
Stanton	79.0	14, 15	8	11
Simmons	32.0	23, 24	8	11
Pickerel	24.0	24, 25	8	11
Bass	42.0	25	8	11
Cranberry	26.0	26	8	11
Mitchell	24.0	26, 35	8	11
Minden City No. 1	6.0	6	13	14
Minden City No. 3	8.0	6	13	14
Minden City No. 2	10.0	6	13	14
Minden City No. 4	10.0	—	13	14

Note—In addition, about 25 small lakes or ponds, ranging in size up to 5 acres, are distributed throughout the basin. From Michigan Lake Inventory Bulletin Nos. 44, 74, 77 by C. R. Humphrys and R. F. Green





THE RECURRENCE OF ANNUAL HIGH AND LOW-FLOWS FOR SELECTED PERIODS MAY BE DETERMINED FROM FREQUENCY CURVES

The high flows are governed principally by climate and basin physiography. Low-flows are indicative of ground water contribution to streamflow and depend chiefly on geohydrologic conditions

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WATER RESOURCES OF THE BLACK RIVER BASIN, SOUTHEASTERN MICHIGAN

By
R. L. Knutilla

1970

For sale by U.S. Geological Survey, price $1.75 per set
Explanatory pamphlet accompanies map